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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/681,497	10/08/2003	Stephen G. Bales	LA 001	5906

48373 7590 10/21/2005

STEPHEN G. BALES
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EXAMINER	
DANIELS, MATTHEW J	
ART UNIT	PAPER NUMBER
1732	

DATE MAILED: 10/21/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Interview Summary	Application No.	Applicant(s)	
	10/681,497	BALES, STEPHEN G.	
	Examiner	Art Unit	
	Matthew J. Daniels	1732	

All participants (applicant, applicant's representative, PTO personnel):

(1) *Matthew J. Daniels*.

(2) *Michael Colaianni*.

(3) *Stephen Bales*.

(4) *Sandra Bales*.

Date of Interview: *13 October 2005*.

Type: a)☒ Telephonic b)☐ Video Conference
c)☐ Personal [copy given to: 1)☐ applicant 2)☐ applicant's representative]

Exhibit shown or demonstration conducted: d)☐ Yes e)☒ No.
If Yes, brief description: ______.

Claim(s) discussed: *1-3,6 and 31*.

Identification of prior art discussed: *Lloyd (USPN 6368529), Aida (USPN 5221781), and Chow (USPN 5130352)*.

Agreement with respect to the claims f)☐ was reached. g)☒ was not reached. h)☐ N/A.

Substance of Interview including description of the general nature of what was agreed to if an agreement was reached, or any other comments: *See Continuation Sheet*.

(A fuller description, if necessary, and a copy of the amendments which the examiner agreed would render the claims allowable, if available, must be attached. Also, where no copy of the amendments that would render the claims allowable is available, a summary thereof must be attached.)

THE FORMAL WRITTEN REPLY TO THE LAST OFFICE ACTION MUST INCLUDE THE SUBSTANCE OF THE INTERVIEW. (See MPEP Section 713.04). If a reply to the last Office action has already been filed, APPLICANT IS GIVEN ONE MONTH FROM THIS INTERVIEW DATE, OR THE MAILING DATE OF THIS INTERVIEW SUMMARY FORM, WHICHEVER IS LATER, TO FILE A STATEMENT OF THE SUBSTANCE OF THE INTERVIEW. See Summary of Record of Interview requirements on reverse side or on attached sheet.

Michael P Colaianni

MICHAEL P. COLAIANNI
SUPERVISORY PATENT EXAMINER

Examiner Note: You must sign this form unless it is an Attachment to a signed Office action.

Matthew J Daniels

Examiner's signature, if required

Summary of Record of Interview Requirements

Manual of Patent Examining Procedure (MPEP), Section 713.04, Substance of Interview Must be Made of Record
A complete written statement as to the substance of any face-to-face, video conference, or telephone interview with regard to an application must be made of record in the application whether or not an agreement with the examiner was reached at the interview.

Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews
Paragraph (b)
In every instance where reconsideration is requested in view of an interview with an examiner, a complete written statement of the reasons presented at the interview as warranting favorable action must be filed by the applicant. An interview does not remove the necessity for reply to Office action as specified in §§ 1.111, 1.135. (35 U.S.C. 132)

37 CFR §1.2 Business to be transacted in writing.
All business with the Patent or Trademark Office should be transacted in writing. The personal attendance of applicants or their attorneys or agents at the Patent and Trademark Office is unnecessary. The action of the Patent and Trademark Office will be based exclusively on the written record in the Office. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is disagreement or doubt.

The action of the Patent and Trademark Office cannot be based exclusively on the written record in the Office if that record is itself incomplete through the failure to record the substance of interviews.

It is the responsibility of the applicant or the attorney or agent to make the substance of an interview of record in the application file, unless the examiner indicates he or she will do so. It is the examiner's responsibility to see that such a record is made and to correct material inaccuracies which bear directly on the question of patentability.

Examiners must complete an Interview Summary Form for each interview held where a matter of substance has been discussed during the interview by checking the appropriate boxes and filling in the blanks. Discussions regarding only procedural matters, directed solely to restriction requirements for which interview recordation is otherwise provided for in Section 812.01 of the Manual of Patent Examining Procedure, or pointing out typographical errors or unreadable script in Office actions or the like, are excluded from the interview recordation procedures below. Where the substance of an interview is completely recorded in an Examiners Amendment, no separate Interview Summary Record is required.

The Interview Summary Form shall be given an appropriate Paper No., placed in the right hand portion of the file, and listed on the "Contents" section of the file wrapper. In a personal interview, a duplicate of the Form is given to the applicant (or attorney or agent) at the conclusion of the interview. In the case of a telephone or video-conference interview, the copy is mailed to the applicant's correspondence address either with or prior to the next official communication. If additional correspondence from the examiner is not likely before an allowance or if other circumstances dictate, the Form should be mailed promptly after the interview rather than with the next official communication.

The Form provides for recordation of the following information:
- Application Number (Series Code and Serial Number)
- Name of applicant
- Name of examiner
- Date of interview
- Type of interview (telephonic, video-conference, or personal)
- Name of participant(s) (applicant, attorney or agent, examiner, other PTO personnel, etc.)
- An indication whether or not an exhibit was shown or a demonstration conducted
- An identification of the specific prior art discussed
- An indication whether an agreement was reached and if so, a description of the general nature of the agreement (may be by attachment of a copy of amendments or claims agreed as being allowable). Note: Agreement as to allowability is tentative and does not restrict further action by the examiner to the contrary.
- The signature of the examiner who conducted the interview (if Form is not an attachment to a signed Office action)

It is desirable that the examiner orally remind the applicant of his or her obligation to record the substance of the interview of each case. It should be noted, however, that the Interview Summary Form will not normally be considered a complete and proper recordation of the interview unless it includes, or is supplemented by the applicant or the examiner to include, all of the applicable items required below concerning the substance of the interview.

A complete and proper recordation of the substance of any interview should include at least the following applicable items:
1) A brief description of the nature of any exhibit shown or any demonstration conducted,
2) an identification of the claims discussed,
3) an identification of the specific prior art discussed,
4) an identification of the principal proposed amendments of a substantive nature discussed, unless these are already described on the Interview Summary Form completed by the Examiner,
5) a brief identification of the general thrust of the principal arguments presented to the examiner,
   (The identification of arguments need not be lengthy or elaborate. A verbatim or highly detailed description of the arguments is not required. The identification of the arguments is sufficient if the general nature or thrust of the principal arguments made to the examiner can be understood in the context of the application file. Of course, the applicant may desire to emphasize and fully describe those arguments which he or she feels were or might be persuasive to the examiner.)
6) a general indication of any other pertinent matters discussed, and
7) if appropriate, the general results or outcome of the interview unless already described in the Interview Summary Form completed by the examiner.

Examiners are expected to carefully review the applicant's record of the substance of an interview. If the record is not complete and accurate, the examiner will give the applicant an extendable one month time period to correct the record.

Examiner to Check for Accuracy

If the claims are allowable for other reasons of record, the examiner should send a letter setting forth the examiner's version of the statement attributed to him or her. If the record is complete and accurate, the examiner should place the indication, "Interview Record OK" on the paper recording the substance of the interview along with the date and the examiner's initials.

Continuation of Substance of Interview including description of the general nature of what was agreed to if an agreement was reached, or any other comments: Mr. Bales discussed the points listed on the enclosed arguments and slides. In particular, Mr. Bales stated that Aida does not teach fungicide, and teaches that the range down to 5 parts by weight pertains only to the organic flame retardants. Mr. Bales stated that Aida requires that the inorganic zinc borate compounds must be used in the range of 40 to 200 parts by weight, and cited Aida's teachings in 7:17-20. The Examiner stated that the rejection of Claim 1 under 35 USC 102(b) would be maintained because all method limitations of claim 1 are still anticipated. The Examiner agreed that the amount of borates taught by Aida (7:17-20) appears to be greater than those sought in Claims 2 and 3, and further agreed that the rejections of claims 2 and 3 would be withdrawn, and a new search performed for these limitations. Mr. Bales stated that there is a distinction between decay and mold damage in wood/plastic composites. Mr. Bales stated that Lloyd teaches calcium borate to combat only decay, and does not teach calcium borate to combat mold. As evidence, Mr. Bales cited the examples shown in Lloyd that use fungi and measure weight loss, and argued that the resistance to mold damage provided in the instant invention is an unexpected result. The Examiner responded that evidence of a longfelt need in the art or a declaration under 37 CFR 1.132 would be further considered in the written response. Mr. Bales stated that Lloyd teaches less of the calcium borate and different particle sizes than those claimed or disclosed in the instant invention. The Examiner stated that portions of the weight percent range claimed and portions of the particle size ranges disclosed in the instant application are taught by Lloyd and are still obvious. Mr. Bales stated that there is no motivation to combine Aida and Lloyd because the motivation given in the office action, namely the flow and burn characteristics, would not motivate one to use these additives in Aida's method because neither is pertinent to wood/plastic composites.. The Examiner responded that Lloyd's teaching of the undesirability of zinc borates because of their wear properties when sawing or cutting (1:50-55) in favor of calcium borate would have further motivated one to make the combination. The Examiner further stated that claim 6 still appeared to be obvious under 35 USC 103(a). Mr. Bales additionally stated that the 10/909,053 application does not constitute double patenting because zinc borates are hydrophilic. In the reference to Nadkarni, the solution is only hydrophilic when combined with other components. Mr. Bales stated that the 11/149,808 application does not constitute double ~~pa~~patenting because zinc oxide combined with borate compounds produces a synergistic effect and lower cost. The Examiner stated that these arguments would be further considered in the written response. The proposed response faxed for discussion purposes will be made of record.

MICHAEL P. COLAIANNI
SUPERVISORY PATENT EXAMINER

LORD'S ADDITIVES LLC

856-415-1374 856-415-0227 (F))

FACSIMILE TRANSMITTAL SHEET

TO: Matthew Daniels	FROM: Stephen Bales
COMPANY: USPTO	DATE: 10/11/2005
FAX NUMBER: 571-273-2450	TOTAL NO. OF PAGES INCLUDING COVER: 18
PHONE NUMBER: 571-272-2450	SENDER'S REFERENCE NUMBER:
RE:	YOUR REFERENCE NUMBER:

☐ URGENT X FOR REVIEW ☐ PLEASE COMMENT ☐ PLEASE REPLY ☐ PLEASE RECYCLE

NOTES/COMMENTS:

Mr. Daniels,

Regarding APPL 10/681,497-- Attached is an amendment to page 15 of the draft response we faxed you last week.

Also attached in an 9 page presentation that summarizes our draft response, and which we will review during the telephone interview on Thur Oct 13th at 3pm. Unless there are many questions or comments, we would expect the interview to be complete within 30 minutes.

Finally, we would like confirmation ofthe phone number for the conference room – we know it is 571-272 but can not read out notes for the last 4 digits.

Regards,

Stephen Bales

b. Lloyd teaches that an advantage of calcium borate used in WC's is the improved disposal of scrap material by burning (2:16-19 and Example 2). With plastic resins, this is not an applicable advantage, since unlike the waste from WC's, the valuable plastic scrap material can be, and is, recycled to reduce manufacturing costs.

2. Lloyd's statement that calcium borate particle size is not critical (preferred range is 150 to 10 microns) in WC's teaches away from the assertion in this present invention that in WPC's particle size is critical (preferred range is 20 to 5 microns).
3. Lloyd teaches that the preferred calcium borates as preservatives in WC's are calcium polytriborates (3:35-36), while the present invention teaches the selection of the calcium borate type on an economic basis rather than a chemical basis.

Finally, the present invention asserts that a combination of factors including the control of calcium borate's particle size, the robustness of the plastic resin, and the ability of the calcium borate to interact favorably with other additives results in a preferred range for optimum performance against decay of approximately half that required for lignocellulosic thermosetting composites.

In summary, due to the differences in WPC's and WC's, the OA prior art references do not contain a suggestion or motivation for their combination and further Lloyd teaches away from a key factor in this present invention. Therefore Applicant requests a reversal of the Office Action position on claims 18, 22, 24, 25,& 26 (13, 16, 17, 18, & 19 after amendments).

Lignocellulosic, Borate Filled, Thermoplastics

Appl 10/681,497

Summary of response to OA of Aug 8, 2005

Stephen Bales
October 12, 2005

Background

Decking materials (boards, rails) constitute the primary commercial use of Lignocellulosic thermoplastic materials in the US

- The cellulosic meterial has been predominately wood and therefore the material is commonly referred to as Wood-Plastic Composites (WPC's)

- Since WPC's contain 25 - 40% plastic resin, their cost is higher than the main alternative-- treated lumber
  - this makes economics a very important factor in the solution to any WPC problem

Invention Objectives

- **The objectives of Appl '497 address two issues associated with WPC material:**

1. Provide economic, environmentally safe method to resist surface WPC visual impairment caused by mold --re Claims 1-15 (1-10 after amendments)
   - growing source of customer complaints
     - expectation was a "maintenance free" product
       - especially troubling to customers since WPC's are more expensive than alternatives

2. Provide economic, environmentally safe method to increase WPC's resistance to decay caused by wood destroying fungus called *Wood Rotting Basidiomycetes* (WRB)
   --re Claims 16 -31 (11 - 19 after amendments)

   - has the potential to cause structural damage to the WPC deck boards

PAGE 5/11 * RCVD AT 10/12/2005 9:50:43 AM [Eastern Daylight Time] * SVR:USPTO-EFXRF-6/25 * DNIS:2732450 * CSID:856 415 0227 * DURATION (mm-ss):02-34

Appl 10/681,497 Reply to OA

Reply to 35 USC § 103 Rejection of claim 6 based on Lloyd (6368529) into Aida:

Claim 6 is part of Objective 1 -- Increase resistance to WPC Surface Impairment

Lloyd teaches calcium borate as a preservative for decay fungus in lignocellulosic thermosetting composites, often referred to as Wood Composites (WC's)

1. Lloyd neither teaches or even suggests the use of calcium borate to resist surface impairment
   - abstract discusses wood destroying fungi - tests utilize WRB fungi and discuss weight loss
   - no visual measurements - ranges lower than those rqd to control surface mold
2. Present invention resulted in an unexpected discovery --
   -- borate compounds, including calcium borate, can provide significant resistance to WPC surface impairment even though borate is dispersed throughout the extruded product
3. Present invention produced a surprising result
   -- mold resistance is achieved at economic loading ranges

Summary: Recommend reversal of OA position on claim 6 since the differences between this invention and prior art are significant and unique (ie unobvious)

Appl 10/681,497 Reply to OA

Reply to 35 USC § 1R03 Rejection of claims 22 (now 16), 24 (now 17), 25 (now 18) and 26 (now 19) based on Lloyd (6368529) into Aida:

Claims are part of Objective 2: Increase resistance to WPC decay

1. Advantages taught by Lloyd for WC's do not apply to WPC's
   - WPC scrap can be and is recycled, not burned, for economic and environmental reasons
   - WPC additives are pre-mixed and compounding equipment is well suited to processing varying types of powders, eliminating any flow advantage of calcium borate
2. Lloyd teaches particle size control is not important in WC's , current invention asserts particle control is important in WPC's
3. Lloyd teaches preferred calcium borates in WC's are calcium polytriborates (3:35-36); present invention teaches WPC calcium borate type should be selected on economic basis.

Summary: No motivation to combine referenced teachings and prior art references do not suggest limitations of the present invention.

Recommend reversal of OA position on these claims.

Appl 10/681,497 Reply to OA

Reply to 35 USC § 103 Rejection of Claim 31 (now part of claim 16) based on Aida in view of Chow (5130352)

- Chow teaches the use of boric acid in thermoplastics to reduce odor
  - no preservative type testing for decay
  - all testing is done immediately after manufacture for odor
- no teaching or suggestion that boric acid can be used as a preservative to resist decay in WPC's

Summary: '497 provides a new, unique use for boric acid. Recommend reversal of OA position.

Appl 10/681,497 Reply to OA

Reply to 35 USC § 102 Rejection of Claims 1-5, 14-17, 20, 21, 31 based on Aida

OA states Aida teaches method for forming products incorporating a boron containing fungicide in lignocellulosic thermoplastics

The purpose of Aida teaching was the formation of a thermoplastic that could accommodate a number of flame retardants and retain critical properties

- Although Aida does teach the use of zinc borate, zinc metaborate, and barium metaborate, the purpose for their incorporation is as a flame retardant
  - these 3 compounds have a history as fire retardant additives
    - zinc borate was initially developed in the late 60's as a fire retardant and has a long history for this use
  - the 3 compounds are listed with 19 other compounds, all of which are fire retardants

Summary: Aida neither discloses, or suggests, the use of a boron compound as a fungicide. Recommend reversal of OA position.

Double Patenting Appl 10/909,053

- Both zinc borate and calcium borate are hydroscopic
  - reference manuals/documents cited in IDS (First Supplement)
  - lab results conducted by applicant confirms references

- invention made the discovery of an economic method of producing low dust zinc borate and calcium borate powder that has flow properties comparable to the regular material
  - **important discovery that solves two problems experienced by users of these compounds**
    - dust in the manufacturing workplace
    - loss of material during manufacturing (economic impact)

Double Patenting Appl 11/149,808

- Invention claims a new discovery:

When combined with zinc borate or calcium borate in the prescribed ratios, zinc oxide is synergistic with these compounds when used as a preservative in WPC's or WC's.

- Zinc oxide does not have a WPC or WC preservative capability by itself
- The synergistic effect provides an economic advantage

LORD'S ADDITIVES LLC

856-415-1374 856-415-0227 (F))

FACSIMILE TRANSMITTAL SHEET

TO: Matthew Daniels	FROM: Stephen Bales
COMPANY: USPTO	DATE: 9/28/2005
FAX NUMBER: 571-273-2450	TOTAL NO. OF PAGES INCLUDING COVER: 18
PHONE NUMBER: 571-272-2450	SENDER'S REFERENCE NUMBER:
RE:	YOUR REFERENCE NUMBER:

☐ URGENT X FOR REVIEW ☐ PLEASE COMMENT ☐ PLEASE REPLY ☐ PLEASE RECYCLE

NOTES/COMMENTS:

Mr. Daniels,

Attached is the 17 page APPENDIX associated with draft response to the Office Action (OA) of August 8, 2005 regarding Appl # 10/681,497.

Regards,

Stephen Bales

APPLICATION 10/681497
DRAFT APPENDIX

Patent Application of

Stephen G. Bales

for

TITLE: Lignoellulosic, Borate Filled, Thermoplastic Composites

CROSS-REFERENCE TO RELATED APPLICATIONS: 60/427,113-filing 11/18/2002

FEDERALLY SPONSORED RESEARCH: None

SEQUENCE LISTING: None

BACKGROUND:

[0001] This invention relates to lignocellulosic composites, and more particularly, to lignocellulosic, borate filled, thermoplastic composites.

[0002] There is a very high demand for wood products. Although wood is a renewable resource, it takes many years for trees to mature. Consequently, the supply of wood suitable for use in construction is decreasing and there is a need to develop alternatives.

[0003] Lignoelluosic materials, such as wood, sawdust, rice hulls, and the like have long been added to thermoplastic resins such as polyethylene, polypropylene and polyvinyl chlorine (PVC) to achieve a wood-like composite providing reinforcement, reduced coefficient of expansion, and cost reduction. Process methods have been developed to enable blends containing materials having low bulk density (ie. powders) and poor flow characteristics to be fed at commercially acceptable rates. Blends of this type can be extruded through dies of appropriate configuration to produce building product type

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shapes previously made from wood. When these thermoplastic composites were first introduced, the prevailing theory was that the plastic protected the cellulose from fungal attack. However research by Verhey, Laks, and Richer, described in "Laboratory Decay Resistance of Woodfiber/Thermoplastic Composites", Forest Products Journal, September 2001 revealed that lignocellulosic thermoplastics are susceptible to damage from fungal decay. Degradation due to the fungal attack is a problem that threatens the material's structural integrity. In contrast, surface discoloration and spotting has been reported shortly after the introduction of thermoplastic composites. This visual degradation, caused by mold, is a significant problem since major commercial uses of lignocellulosic thermoplastic composites, including decking and fencing, rely on their aesthetic appeal to compete in the marketplace.

[0004] Traditionally, solid wood products are dipped or pressure treated with solutions of fungicides to provide resistance to fungus and mold damage. While this type of treatment is not practicable for a thermoplastic product, it is possible to incorporate a fungicide into the product during its manufacture. This approach provides a constant loading of fungicide throughout the material's thickness, increasing the resistance to leaching of the fungicide from the composite. However it diminishes surface concentration of the fungicide, reducing its effectiveness against surface mold attack.

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Anhydrous borate and zinc borate have been used successfully to provide fungal decay at relatively low levels, typically less than 1.5 percent, in lignocellulosic compounds formed from small fractions of wood bonded with an adhesive binder of phenol-formaldehyde resin as described in US Patent 4,879,083. Zinc borate has also been described in the literature as providing resistance to fungal decay in lignocellulosic filled thermoplastics. Research on zinc borate's use as an anti-fungal additive in lignocellulosic thermoplastics has focused on the minimum loading required to increase resistance to fungal decay, while neglecting to consider or investigate the effect of those higher loading levels required to provide resistance to visual deterioration caused by surface molds.

[0005] Although not used commercially as a fungicide, calcium borate is described in US Patent No 6,368,529 and Patent Application No 20020182431 as providing protection against fungal decay and insects in lignocellulosic compounds formed from small fractions of wood bonded with an adhesive binders of phenol-formaldehyde, phenol-resorcinol-formaldehyde, urea-formaldehyde, and diphenylmethanediisocyanate at preferred levels of 1.5% to 15%. All investigation done on the use of calcium borate as a fungicide has focused on its ability to resist fungal decay in lignocellulosic composites such as particleboard, waferboard, oriented strandboard, and medium density fiberboard that use these thermosetting resins.

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[0006] The use of calcium borate as a fungicide to increase resistance to fungal decay in lignocellulosic thermoplastics is identified in patent application 20030071389 but has not been studied. The use of calcium borate to increase resistance to surface discoloration caused by surface mold has never been identified or studied, either in lignocellousic composites, which use adhesive binders such as formaldehyde- isocynate-based resins, and or lignocellousic thermoplastic composites using resins including polyethylene, polyethylene, and polyvinyl chloride.

[0007] Currently the lignocellousic thermoplastics industry is faced with two preservation needs: (1) finding an economic method of improving resistance to fungal decay and (2) developing an economic method for improving resistance to the visual damage caused by surface mold.

SUMMARY AND OBJECTIVES OF THE INVENTION

[0008] The present invention, which addresses the above needs, is the incorporation of borates to improve the durability of lignocellulosic thermoplastic products. More specifically it relates to the use of boron-containing fungicides as a preservative to economically increase the resistance of lignocellulosic thermoplastic products to structural decay caused by fungus and to increase the resistance to the visual impairment of the product's surface caused by mold.

[0009] It is an object of the invention is to provide an economic, environmentally safe method of increasing the resistance of a lignocelloulsic thermoplastic to fungal decay.

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This is accomplished by the introduction of economic, low toxicity borate materials including calcium borate and boric acid.

[0010] It is a further objective of the invention is to provide an economic, environmentally safe method whereby the lignocellousic thermoplastic has an increased resistance to surface discoloration and other visual impairments caused by mold. It was discovered this can only be accomplished by increasing the borate loading above the ~~2~~ 1 percent level by weight. The invention utilizes the robust nature of the thermoplastic binders to accommodate these increased loadings without creating strength or dimensional problems and resulted in the unexpected discovery that borate loading levels as low as ~~3~~ 1 percent produce an improvement, and loadings of about 2.5 percent produce a significant improvement, in resistance to surface visual impairment caused by mold.

DETAILED DESCRIPTION

[0011] The lignocellulosic thermoplastic composites of this invention are produced by well known procedures that combine molten plastic with lignocellulosic fiber and additional additives such as lubricants, process aids, cross-linking agents, inhibitors, stabilizers, blowing agents, foaming agents and other additives known in the art. Examples of suitable thermoplastics include polyethylene (PE), high density polyethylene (HDPE), polystyrene (PS), and polyvinyl chloride (PVC) with loadings by weight from 25% to 75%. This process is further described in U.S. Patent No. 5,516,472 (May, 1996). Examples of suitable cellulosic material include wood, ground rice hulls, kenaf, jute, and coconut shells.

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[0012] The methods for manufacturing cellulosic filled thermoplastic are well known and the specific procedure will be dependent on the cellulosic raw material, the plastic, and the type of cellulosic thermoplastic composite desired. However, in general the raw materials are mixed together in a compounding process and the compounded material is then formed into the desired product. Compounding is the feeding and dispersing of fillers and additives, including the fungicide which is in powder form, into the molten polymer using either batch or continuous mixers. The compounded material then is either immediately pressed into the end product or formed into pellets for future processing.

[0013] As used in this invention, the term "boron-containing fungicide" includes calcium borate, zinc borate, and boric acid. The calcium borate which can be used in the method of this invention may be any of the borate compounds containing calcium, boron, and oxygen. ~~The calcium borates include the calcium polytriborates, with a CaO:B.sub2 O.sub3 ratio of 2:3 and the calcium hexaborates with a CaO:Bsub2 O.sub.3 ratio of 1:3. Calcium hexaborates include nobleite and gowerite. Optionally, calcium-sodium borates and calcium-magnesium borates may be used; examples include ulexite, probertite and hydroboracite.~~ This includes calcium borates that may be synthetically producted or naturally occurring borates including colemanite, ulexite, nobelite, hydroboracite, and gowerite.

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[~~0014~~] ~~The preferred boron-containing fungicide for this invention are the calcium polytriborates, which may be synthetically produced or a naturally occurring borate such as colemanite or inyonite.~~

[0015] The exact particle size of the boron-containing fungicide ~~is not critical, but the material~~ must be of a size that can be dispersed uniformly throughout the lignocellulosic thermoplastic composite. Generally a mean particle size as large as ~~150~~ 50 microns and as small as ~~1 micron~~ 3 microns can be used. For best results the mean particle size should be in the range of ~~40~~ 20 microns to 5 microns.

[0016] The amount of boron-containing fungicide incorporated into the lignocellulosic thermoplastic composite will depend on the lignocellulosic content, the longevity desired and the anticipated exposure to moisture. In general, when resistance to decay caused by fungus is required, a range of about ~~0.2~~ 0.1 to ~~5~~ 2 percent by weight of the fungicide is required. The preferred amount is about 0.3 to ~~2~~ 1 percent. ~~for lignocellulosic loadings less than 60 percent and about 2 to 4 percent for lignocellulosic loadings greater than 60 percent.~~

[0017] When resistance to visual impairment to the surface caused by mold is required, the amount will be in the range of about ~~2~~ 1 to ~~12~~ 10 percent. The preferred amount is about ~~3~~ 2.5 to 5 percent.

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EXAMPLES

Example 1

Lignocellulosic thermoplastic material was produced using a Brabender Conical Twin Screw Extruder with a counter rotating venting screws and forced through a spring die into test samples 40 cm by 5 cm by 0.2 cm. Prior to extrusion the test samples were blended on a Littleford W-10 mixer as identical mixtures of High Density Polyethylene (HDPE) (>25%), Wood (>40%), Talc (>5%) and Mica (>1%) but with Colemanite loadings of 1, 2, 3, 4, and 5 percent by weight. A sample containing no Colemanite was produced as the control. The Colemanite grade was 47.5 % B.sub.2 O.sub.3 with an average particle size of 7 microns, the HDPE was a BP Solvay virgin reactor flake, and the wood was oak.

The five test samples and the control sample were placed in an outdoor exposure for eighteen (18) months. Visual observations and color recordings using with a Macbeth Color-Eye 7000A spectrophotometer were taken at 6, 12, and 18 months (see Table I). When , after 18 months, the six samples were placed next to one another in ascending order by the level of colemanite content a visible improvement was evident as the level of colemanite increased. The control sample had darkened in appearance considerably more that the colemanite containing samples as can be confirmed by the color data shown in Table 1. Improvement was noted starting with the 1 percent sample, while samples containing 3, 4, and 5 percent colemanite [are] were all relatively similar in color and obtained the best visual appearance of the six sample set.

As the results show, this calcium borate based material can improve resistance to visual impairment caused by surface mold.

DRAFT APPENDIX

Table 1

Sample	L	a	b	ΔL	Δa	Δb	ΔE
Control							
Initial	64.713	2.266	10.328				
6 month	68.443	0.172	2.879	3.730	-2.095	-7.431	8.574
12 month	64.438	-0.009	1.951	-0.275	-2.276	-8.377	8.685
18 month	63.158	0.007	1.944	-1.555	-2.260	-8.384	8.821
Colemanite 1 %							
Initial	64.968	2.558	10.493				
6 month	69.138	0.181	2.836	4.170	-2.378	-7.657	9.037
12 month	65.673	0.033	2.286	0.705	-2.525	-8.207	8.616
18 month	64.609	0.033	2.406	-0.359	-2.525	-8.087	8.480
Colemanite 2 %							
Initial	65.675	2.382	10.059				
6 month	69.278	0.217	2.903	3.603	-2.165	-7.156	8.299
12 month	67.195	-0.031	2.154	1.519	-2.413	-7.905	8.404
18 month	65.348	0.050	2.469	-0.327	-2.332	-7.590	7.947

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Sample	L	a	b	ΔL	Δa	Δb	ΔE
Colemanite 3 %							
Initial	66.452	2.298	9.921				
6 month	69.884	0.171	2.923	3.392	-2.127	-6.998	8.062
12 month	68.417	-0.021	2.331	1.965	-2.319	-7.590	8.176
18 month	66.678	0.057	2.797	0.226	-2.241	-7.124	7.471
Colemanite 4 %							
Initial	65.957	2.307	9.824				
6 month	68.272	0.195	3.102	2.315	-2.112	-6.722	7.417
12 month	68.208	0.020	2.572	2.251	-2.286	-7.253	7.930
18 month	66.048	0.115	3.075	0.091	-2.192	-6.749	7.097
Colemanite 5 %							
Initial	66.106	2.353	10.087				
6 month	69.661	0.187	3.010	3.554	-2.166	-7.077	8.210
12 month	67.495	0.000	2.514	1.388	-2.352	-7.572	8.050
18 month	66.964	0.066	2.914	0.857	-2.286	-7.173	7.277

Example 2

Lignocellulosic thermoplastic material was produced using a Brabender Conical Twin Screw Extruder with a counter rotating venting screws and forced through a spring die into test samples 40 cm by 5 cm by 0.2 cm. Prior to extrusion two sets of samples were blended on a Littleford W-10 mixer; set 1 contained Wood (70%), High Density Polyethylene (HDPE) (<30%), Talc (>5%) and Mica (>1%) while set 2 was identical but with the addition of a 2 percent Colemanite loading by weight. The Colemanite grade was 47.5 % B.sub.2 O.sub.3 with an average particle size of 7 microns, the HDPE was a BP Solvay virgin reactor flake, and the wood was oak.

The samples were sanded and trimmed to 3.2 cm by 2 cm by 0.2cm. Labeled samples were supported on plastic mesh in the bottom of beakers to allow water circulation completely around the samples, covered with 250mL of distilled water, and soaked continuously for 14 days at ambient pressure and temperature. The test specimens were then dried at 40°C to dry for 7 days. Then, the test specimens were placed in a 27 °C, 90% humidity environment for 20 days prior to soil block testing.

The soil block test was conducted in accordance with the American Wood-Preservers Association (AWPA) standard procedure E10-91 with the exception that the brown rot samples were placed in jars at the time of inoculation. The white rot fungus *Trametes* versicolor and the brown rot fungus *Gloeophyllum trabeun* were used for the test. Solid wood controls were paper birch and southern yellow pine (SYP) for the white and brown rot tests, respectively as a test of fungal vigor. The following results were obtained:

DRAFT APPENDIX

Table 2a

SOIL BLOCK TEST RESULTS

White Rot test (*Gloephyllum trabeum)*

Sample Group	Sample #	Weight Loss%	Average %	Std Deviation %
Untreated Birch Control	B-1	67.1		
	B-2	63.9		
	B-3	66.9		
	B-4	66.9		
	B-5	65.1	66.0	1.4
Sample Set 1 No preservative	1-1	33.1		
	1-2	39.6		
	1-3	40.4		
	1-4	26.0		
	1-5	37.8	35.4	6.0
Sample Set 2 2% Colemanite	2-1	5.1		
	2-2	4.7		
	2-3	2.2		
	2-4	4.8		
	2-5	2.7	3.9	1.4

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Table 2b

Brown Rot test (*Gloephyllum trabeum)*

Sample Group	Sample #	Weight Loss%	Average %	Std Deviation %
Untreated SYP Control	P-1	62.0		
	P-2	48.6		
	P-3	50.7		
	P-4	43.0		
	P-5	40.8	49.0	8.3
Sample Set 1 No preservative	1-6	38.6		
	1-7	35.2		
	1-8	36.5		
	1-9	38.1		
	1-10	41.7	38.0	2.5
Sample Set 2 2% Colemanite	2-6	11.2		
	2-7	11.8		
	2-8	3.0		
	2-9	9.4		
	2-10	9.6	9.0	3.5

As the above results show, this calcium borate based additive was effective at controlling *Trametes* versicolor and *Gloeophyllum trabeum*. And, as discovered above, at even this relatively low loading the additive would improve resistance to surface discoloration caused by mold.

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CLAIMS

What is claimed is:

1. In the method for forming lignocellulosic thermoplastic composite products such as to increase their resistance to surface visual impairment caused by mold attack, the improvement which comprises incorporating an amount of boron-containing fungicide prior to forming said composite product.
2. The method according to claim 1 in which said amount of fungicide is in the range of from about ~~2~~ 1 to about ~~12~~ 10 percent of said composite product.
3. The method according to claim 1 in which said amount of fungicide is in the range of from about ~~3~~ 2.5 to about 5 percent of said composite product.
4. The method according to claim 1 in which said lignocellulosic material is selected from the group consisting of wood, ground rice hulls, kenaf, jute, and coconut shells.
5. The method according to claim 1 in which said thermoplastic material is selected from the group consisting of polyethylene, high-density polyethylene, polystyrene, and polyvinyl chloride.
6. The method according to claim 1 in which said boron-containing fungicide is selected from a group consisting of calcium borate, zinc borate, boric acid, or a mixture thereof.

~~7. The method according to claim 6 in which said calcium borate is selected from the group consisting of calcium polytriborate, calcium hexaborate, calcium-sodium borate, calcium-magnesium borate and calcium metaborate.~~

~~8~~ 7 The method according to claim 6 in which said calcium borate is a naturally occurring borate.

~~9~~ 8 The method according to claim ~~8~~ 7 in which said calcium borate is selected from the group consisting of nobleite, gowerite, hydroboracite, ulexite and colemanite.

~~10~~ 9 The method according to claim 6 in which said calcium borate is a synthetic borate.

~~11 The method according to claim 10 in which said calcium borate is selected from the group consisting of calcium metaborate, calcium polytriborate and calcium hexaborate.~~

~~12 The method according to claim 6 in which said calcium borate is a calcium polytriborate having a CaO:B.sub.2 O.sub.3 molar ratio of about 2:3.~~

~~13 The method according to claim 6 in which said calcium borate is a calcium hexaborate having a CaO:B.sub.2 O.sub.3 molar ratio of about 1:3.~~

~~14 The method according to claim 1 in which said boron-containing fungicide is selected from the group consisting of zinc borate and boric acid.~~

~~15~~ 10 The method according to claim 1 in which said lignocellousic material is wood.

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~~16.~~ 11 In the method for forming lignocellulosic thermoplastic composite products which increase their resistance to fungal attack, the improvement which comprises incorporating an amount of boron-containing fungicide prior to forming said composite product.

~~17~~ 12 The method according to claim ~~16~~ 11 in which said amount of fungicide is in the range of from about 0.1 to about ~~5~~ 2 percent of said composite product.

~~18~~ 13 The method according to claim ~~16~~ 11 in which said amount of fungicide is in the range of from about 0.3 to about ~~2~~ 1 percent of said composite product.

~~19The method according to claim 16 in which said amount of fungicide is in the range of from about 2 to 4 percent of said composite product.]~~

~~20~~ 14. The method according to claim ~~16~~ 11 in which said lignocellulosic material is selected from the group consisting of wood, ground rice hulls, kenaf, jute, and coconut shells.

~~21~~ 15. The method according to claim ~~16~~ 11 in which said thermoplastic material is selected from the group consisting of polyethylene, high density polyethylene, polystyrene, and polyvinyl chloride.

~~22~~ 16. The method according to claim ~~16~~ 11 in which said boron-containing pesticide is calcium borate, boric acid, or a mixture thereof.

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~~23 The method according to claim 22 in which said calcium borate is selected from the group consisting of calcium polytriborate, calcium hexaborate, calcium metaborate, calcium-sodium borate, and calcium-mangesium borate.~~

~~24~~ 17. The method according to claim ~~22~~ 16 in which said calcium borate is a naturally occurring borate.

~~25~~ 18. The method according to claim ~~24~~ 17 in which said calcium borate is selected from the group consisting of nobleite, gowerite, hydroboracite, ulexite and colemanite.

~~26~~ 19 The method according to claim ~~22~~ 16 in which said calcium borate is a synthetic borate.

~~27 The method according to claim 26 in which said calcium borate is selected from the group consisting of calcium metaborate, calcium poyltriborate and calcium hexaborate.~~

~~28 The method according to claim 21 in which said calcium borate is a calcium polytriborate having a CaO:B.sub.2 O.sub.3 molar ratio of about 2:3.~~

~~29 The method according to claim 21 in which said calcium borate is a calcium hexaborate having a CaO:B.sub.2 O.sub.3 molar ratio of about 1:3.~~

~~30 The method according to claim 16 in which said boron-containing fungicide is boric acid.~~

~~31 The method according to claim 16 in which said lignocellousic material is wood.~~

DRAFT APPENDIX

ABSTRACT OF THE DISCLOSURE

The incorporation of borates during the manufacture of lignocellulosic based thermoplastic materials will increase their resistance to surface impairment caused by mold as well as increase their resistance to fungal decay. For resistance to surface impairment, the preferred amount is ~~3~~ 2.5 to 5 percent of zinc borate, calcium borate, or boric acid. When fungal decay resistance is needed the preferred amount is about ~~0.5~~ 0.3 to ~~2~~ 1 percent of calcium borate or boric acid.

LORD'S ADDITIVES LLC

856-415-1374 856-415-0227 (F))

FACSIMILE TRANSMITTAL SHEET

TO: Matthew Daniels	FROM: Stephen Bales
COMPANY: USPTO	DATE: 9/28/2005
FAX NUMBER: 571-273-2450	TOTAL NO. OF PAGES INCLUDING COVER: 18
PHONE NUMBER: 571-272-2450	SENDER'S REFERENCE NUMBER:
RE:	YOUR REFERENCE NUMBER:

☐ URGENT X FOR REVIEW ☐ PLEASE COMMENT ☐ PLEASE REPLY ☐ PLEASE RECYCLE

NOTES/COMMENTS:

Mr. Daniels,

Attached is the 17 page draft response to the Office Action (OA) of August 8, 2005 regarding Appl # 10/681,497. This response includes references to papers sent to you recently in our First Supplemental Information Disclosure Statement.

We will send the Draft Appendix to this response in a separate fax, since it also is 17 pages.

We will call you in about a week to schedule a time for a telephone interview concerning this Application.

Regards,

Stephen Bales

DRAFT DOCUMENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No.	:	10/681,497
Applicant	:	Stephen G. Bales
Filing Date	:	October 8, 2003
Title	:	Lignocellulosic, Borate Filled, Thermoplastic Composites
Examiner:		Matthew J. Daniels
Art Unit	:	1732
Docket No.	:	LA 001
Customer No.		000048373

September 20, 2005

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In response to the Office Action (OA) of August 8, 2005, please amend the above-identified application as follows"

AMENDMENT

Amendments to the Specification begin on page 2 of this paper

Amendments to the Claims are reflected in the listing on page 4 of this paper. The claims were amended to more closely align with the unique discoveries of the present invention as presented in the arguments contained in this paper.

Remarks/Arguments begin on page 4 of this paper.

An **Appendix** including a "marked up" Specification and Claims and a "clean sheet" Specification and Claims follows the remarks section.

Appl. No. 10/681,497 **DRAFT**
Amdt. Dated Sept 27, 2005
Reply of Office action of Aug. 8, 2005

Amendments to the Specification:

Please replace paragraph [0013] with the following amended paragraph:

[0013] As used in this invention, the term "boron-containing fungicide" includes calcium borate, zinc borate, and boric acid. The calcium borate which can be used in the method of this invention may be any of the borate compounds containing calcium, boron, and oxygen. ~~The calcium borates include the calcium polytriborates, with a CaO:B.sub2 O.sub3 ratio of 2:3 and the calcium hexaborates with a CaO:Bsub2 O.sub.3 ratio of 1:3. Calcium hexaborates include nobleite and gowerite. Optionally, calcium-sodium borates and calcium-magnesium borates may be used; examples include ulexite, probertite and hydroboracite.~~ This includes calcium borates that may be synthetically produced or naturally occurring borates including colemanite, ulexite, nobelite, hydroboracite, and gowerite.

Please delete paragraph [0014]

Please renumber paragraph [0015] as [0014] amended as follows:

~~[0015]~~ [0014] The exact particle size of the boron-containing fungicide ~~is not critical, but the material~~ must be of a size that can be dispersed uniformly throughout the

lignocellulosic thermoplastic composite. Generally a mean particle size as large as ~~150~~ 50 microns and as small as ~~1 micron~~ 3 microns can be used. For best results the mean particle size should be in the range of ~~40~~ 20 microns to 5 microns.

Please renumber paragraph [0016] as [0015] amended as follows:

~~[0016]~~ [0015] The amount of boron-containing fungicide incorporated into the lignocellulosic thermoplastic composite will depend on the lignocellulosic content, the longevity desired and the anticipated exposure to moisture. In general, when resistance to decay caused by fungus is required, a range of about ~~0.2~~ 0.1 to ~~5~~ 2 percent by weight of the fungicide is required. The preferred amount is about 0.3 to ~~2~~ 1 percent ~~for lignocellulosic loadings less than 60 percent and about 2 to 4 percent for lignocellulosic loadings greater than 60 percent.~~

Please renumber paragraph [0017] as [0016] amended as follows:

~~0017]~~ [0016] When resistance to visual impairment to the surface caused by mold is required, the amount will be in the range of about ~~2~~ 1 to ~~12~~ 10 percent. The preferred amount is about ~~3~~ 2.5 to 5 percent.

Amendments to the Claims

Please cancel the following claims without prejudice: 7,11,12,13,14,19,23,27,28,29,and 31.

Please modify the remaining claims as shown in the Appendix.

REMARKS/ARGUMENTS

Favorable reconsideration of the present application is requested.

Office Action (OA) Item 1: Information Disclosure Statement

The article "Protection of Oriented Strandboard with Borate" by Trek, et al is enclosed.

OA Item 2 : Double Patenting

The Office Action states: "**Claims 1-11, 14-27, and 31** are provisionally rejected under the judicially created ..... of copending Application No 11/149,808 in view of Ohkawa (USPN 4891399)".

Ohkawa teaches that zinc oxide is a filler that can be compounded into a thermoplastic resin to enhance its mechanical properties (1:31-39). The Applicant asserts that the use of zinc oxide in the '808 application results in the new discovery that zinc oxide has a synergistic effect when combined with zinc borate and/or calcium borate compounds; this effect enhances their ability to perform as a fungicide and preservative.

Zinc oxide is known to have antifungal characteristics and offers an economic advantage with respect to borate compounds, but by itself is not effective in lignocellulosic composites with either thermosetting or thermoplastic resins.

However Applicant asserts that when combined in the ratios described in the '808 application, there is a synergistic effect whereby a given weight % loading of a combined zinc oxide/zinc borate (or calcium borate) mixture is equally effective as the same weight % loading of only zinc borate (or calcium borate) in preventing decay or surface impairment of lignocellulosic composites. This synergism allows a more cost effective method of providing an important preservative capability for lignocellulosic composite products and is an unexpected result of this invention.

OA Item 3: Double Patenting

The Office Action states: "**Claims 1-4, 6-11, 14-20, 22-27, and 31** are provisionally rejected .... copending Application No 10/909,053 in view of Nadkarni (USPN 5514478)". The OA acknowledges that Claim 1 in the '053 application is different because it includes a dust reducing amount of moisture prior to forming the composite. However the Action then concludes that this difference would have been prima facie obvious to one of ordinary skill because borates including zinc borate are known to be hydrophilic as taught by Nadkarni (4:44-45).

Nadkarni does not teach that zinc borate is hydrophilic but rather teaches that the addition of zinc borate to a solution of nitrilotrismethylenetriphosphonic acid (NTPA), phosphoric acid, and polyacrylic acid will make that complex solution hydrophilic. Applicant asserts that the two borates in the '053 application, zinc borate and calcium borate, are hydroscopic.

The CRC Handbook of Chemistry and Physics, 86th Edition, 2005-2006, p 4-96 states all forms of zinc borate are only slightly soluble in water and the most common commercial form, zinc borate hemiheptahydrate, is insoluble in water. Lloyd (USPN 6368529) confirms zinc borate is of low solubility (1:47-50). The Applicant had zinc borate tested by a Good Lab Practices (GLP) certified laboratory with a result of 0.0032 gm/liter at 20°C, which represents an extremely low solubility material.

Although some alkali borates, such as sodium, potassium, and ammonium borates have solubilities ranging from 2.5 to 43 wt. % at 20°C (Kirk-Othmer, *Encyclopedia of Chemical Technology*, 4th Edition, p 383), calcium borate is an alkaline borate which have low solubilities. For example, colemanite, a calcium borate, has a solubility of 0.1% at 25°C (Kirk-Othmer, p 403).

The uniqueness of '053 is the development of a low dust powder with good flow properties from hydroscopic borate powders. This provides the major new advantage that significantly (75 to 95%) less dust is generated when a commercial size (several hundred pound) bag of zinc borate or calcium borate is discharged in a manufacturing facility that

uses these compounds as a raw material.

The development of a low dust zinc borate and calcium borate powders was not an obvious process. Prior to discovering this invention, experiments were performed by adding 2% and 5% water to the standard zinc borate powder; these experiments resulted in failure. No straightforward spraying, mixing, or agitation technique could be found that uniformly distributed the water throughout the material at these low moisture contents. The resulting power had clumps of agglomerated particles interspersed with standard powder with the result that flowability was unacceptably impaired. Further, even if a relatively economical technique could have been discovered, it still would have increased processing a low dust zinc borate or calcium borate powder above that of this current invention.

The invention described in '053 made the discovery that a low dust powder could be economically produced by controlling the final drying step in the standard zinc borate production process. The resulting low dust powder provides both environmental protection and economic advantage; a lower density of particulate matter exists in the workplace and less powder is lost when the zinc borate or calcium borate is incorporated into the wood composite product. Finally the current invention resulted in two unexpected discoveries:

1. The residual moisture resulting from the invention was so uniformly distributed in the material that the flow properties of the low dust borate compound are equivalent

to those of the regular compound at moisture levels as high as 10 percent.

2. The uniform moisture distribution is so effective at reducing dust that at a moisture level of only 2%, dusting was reduced over 70%. This discovery allows these low dust compounds to be used with both thermosetting and thermoplastic resins.

In summary, this invention allows the manufacturing incorporation of the water insoluble zinc borate and calcium borate preservatives into lignocellulosic thermosetting and thermoplastic composites in an environmentally enhanced, cost efficient manner.

OA Item 4: Claim Rejections – ***35 USC § 102***

The Office Action states: **Claims 1-5, 14-17, 20, 21, and 31** are rejected under 35 U.S.C. 102(b) as being anticipated by Aida (USPN 5221781). It further states "**As to Claim 1,** Aida teaches a method for forming lignocellulosic thermoplastic composite products comprising incorporating an amount of boron-containing fungicide prior to forming the composite product."

Applicant claims that Aida teaches the formation of a thermoplastic resin such that it can accommodate an organic or inorganic flame retardant while retaining key physical properties such as dimensional stability (Abstract). All boron-containing compounds described by Aida are contained in the list of inorganic flame retardants. This list includes three boron compounds: zinc borate, zinc metaborate, and barium metaborate, as well as 19 other compounds each of which is used in thermoplastics as a fire retardant agent (6:63-7:3).

Zinc borate was originally developed as a fire retardant chemical in the late 1960's and has been widely used commercially for this purpose ever since that time. It acts in several ways to control flame spread by accelerating the decomposition of halogen sources that promote char formation, by releasing a low melting glass that can stabilize this char, and by stepwise releasing its waters of hydration. Numerous articles in the flame retardant literature attest to the use of zinc borate as a flame retardant; Applicant has submitted a typical article in entitled "*Effect of Co-Additives on the Flame/Smoke Suppression Properties of Zinc Borates*" in the First Supplemental Information Disclosure Statement.

The OA states that Aida teaches the claimed range (7:12-28). The Applicant asserts that Aida teaches that when using only inorganic flame retardants, and zinc borate is an inorganic flame retardant, the minimum range is 40 parts by weight (7:18-20)

In summary it is clear that the use of zinc borate in USPN 5221781 is as flame retardant. Aida neither discloses, or even suggests, the use of zinc borate, or any boron containing material, as a fungicide.

Item 5: Claim Rejections – *35 USC § 103*

The OA states " **Claims 6-13, 18, 19, 22-29** are rejected under 35 U.S.C. 103(a) as being unpatentable over Aida (USPN 5221781) in view of Lloyd (USPN6368529).

Appl. No. 10/681,497 **DRAFT**
Amdt. Dated Sept 27, 2005
Reply of Office action of Aug. 8, 2005

The present invention describes two distinct objectives regarding lignocellulosic thermoplastic composites: (1) provide an economic, environmentally safe method that increases resistance to surface impairment caused by mold as described in claims 1-15 (1 -10 as amended) and (2) provide an economic, environmentally safe method of increasing the resistance to fungal decay as described in claims 16-30 (11-19 as amended). Lloyd teaches calcium borate as an additive that provides resistance to wood destroying fungus in lignocellulosic thermosetting composites. Therefore it is important to understand the differences in two areas: thermosets vs thermoplastics and wood decay/destruction caused by fungus vs surface impairment caused by molds.

Wood destroying fungus vs wood surface impairment caused by mold

Reference is made to the enclosed document by Forintek Canada Corp., *Understanding Biodeterioration of Wood in Structures,* p 7-11. Page 8 identifies that mold spores disfigure the appearance of the wood surface causing major economic impact. Wood destroying fungus, specifically categorized as Wood-Rotting Basidiomycetes (WRB) on page 8, cause decay of the wood with potential structural implications. A major use of WPC's is in outdoor applications, especially in manufacture of decking material. This environment subjects the WPC products to both WRB's and molds and is the reason that for several years WPC manufacturers have sought economic, environmentally safe solutions to both of these issues, which arise from different causes.

Appl. No. 10/681,497 **DRAFT**
Amdt. Dated Sept 27, 2005
Reply of Office action of Aug. 8, 2005

Applicant submits that Claims 6, 8, 9,& 10 (6,7,8,& 9 as amended) are associated with a new discovery for the use of Calcium Borate that solved an important, unsolved need – resistance to surface visual impairment caused by mold--- and that this discovery produced surprising results:

Claims 6,8,9,& 10 are associated with the first objective of the invention—improving resistance to surface impairment caused by mold. Lloyd teaches calcium borate as an additive that provides resistance to attack by wood destroying fungi and insects (Abstract). Lloyd states " The amount of calcium borate incorporated in the composite is a pesticidal amount; that is, an amount sufficient to control or kill fungi and/or insects that destroy wood and similar cellulosic-based composite products (3:53:-56)." Lloyd's example 1 utilizes *Gloephyllum trabeum* and *Trametes versicolor*, both of which are WRB's described in the Forintek document; his soil block test is the standard approach to testing for decay issues. Lloyd does not teach or even suggest the use of calcium borate to improve resistance to visual impairment of the composite surface.

The present invention teaches that zinc borate, calcium borate, boric acid, and mixtures thereof can be used to increase resistance to surface visual impairment of WPC's caused by mold. This is a new discovery that has not previously be described or even suggested by prior art and addresses a problem that has concerned wood-plastic composite manufacturers for several years. Further, there was a surprising result associated with this discovery. Although the loading ranges were higher than that

required to inhibit wood destroying fungus, they still were low enough to allow a composite to be formed without compromising strength and flexibility. Finally, at these relatively low levels (preferred range is about 2.5% to 5%) this present invention provides an economic method for providing this resistance to surface visual impairment.

In summary, claims 6,8,9, &10 (rewritten as amended claims 6, 7, 8,& 9) are based on the new discovery that zinc borate, calcium borate, boric acid and mixtures thereof can provide lignocellulosic thermoplastic composite's resistance to surface impairment caused by mold accompanied by the surprising result that relatively low levels of these compounds are required to achieve this effect. Therefore Applicant strongly recommends the reversal of the OA position regarding these claims.

Lignocellulosic composites : Thermoplastic vs Thermosetting

Lignocellulosic thermosetting composites (often referred to as wood composites or WC's) are generally manufactured by processing the cellulosic material into appropriate particles called a furnish, mixing the furnish with the resin binder into a desired shape often called a mat, and forming the mat into the final product under heat and pressure. WC's are well known and include particleboard, oriented strandboard(OSB), fiberboard, and laminated strand lumber (LSL). The preferred amounts of resin range from 1.5% to about 15% with a maximum of 25% in materials used for structural purposes.

Thermoplastic (plastic) resins are based on linear or slightly branched polymers in which the molecular chains flow over each other when heated and solidify into new

shapes when cooled. This process of softening with heating and hardening with cooling can be repeated as often as required without introducing chemical changes in the plastic, allowing scrap and waste material to be recycled and reclaimed. Further, lignocellulosic thermoplastic composites (often referred to as wood plastic composites or WPC's) are produced in a considerably different and more complex manner that creates opportunities and challenges for preservative additives not found in thermoset materials. These differences are described by Dr. Craig Clemons in "*Wood-Plastic Composites – The Interfacing of Two Industries*", Forest Products Journal, June 2003, p10-18. WPC's formed with these resins are typically manufactured by mixing many components, including coupling agents, ultraviolet stabilizers, mold release agents, and preservatives in a blender before processing thereby eliminating the advantage of calcium borate's flowability properties over other borate compounds. These components are heated to much higher temperatures (approaching 200°C) in a mixer and the product is then extruded or molded into the desired shape, a process that subjects all the additives to a different environment than that experienced in the WC's.

The differences between WC's and WPC's provide several reasons this present invention was unobvious with respect to prior art; this is described in detail during the following discussion regarding claims 18, 22, 24, 25, & 26.

Appl. No. 10/681,497 **DRAFT**
Amdt. Dated Sept 27, 2005
Reply of Office action of Aug. 8, 2005

Applicant asserts that Claims 18, 22, 24, 25,& 26 (13, 16, 17, 18, & 19 after amendments) are associated with a unobvious use of Calcium Borate in a different material (lignocellulosic thermoplastics):

Regarding claim 18, the OA states that Lloyd teaches the same ranges; for claims 22, 24, 25, &26 the Office Action states Lloyd teaches at least calcium polytriborate and nobleite. These five claims are associated with the second objective of this invention, which describes the use of calcium borate as a preservative to increase resistance against decay in WPC's. The differences between WC's and WPC's result in several conditions that mark a distinct difference between Lloyd and this present invention and illustrate why the use of calcium borate for this purpose was unobvious:

1. The advantages taught by Lloyd regarding the use calcium borate as a preservative in WC's do not exist in WPC's:
    a. The OA states that "It would have been prima facie obvious … calcium borates have much better flow properties, making them easier to store and handle in processing equipment (9:1-15). This is not an advantage for WPC's, since in general the mixing of additive components, including preservatives, is performed prior to initial processing and because the plastics manufacturing equipment must accommodate a wide range of additives they have been designed to accommodate a wide range of materials with varying flowability characteristics.

b. Lloyd teaches that an advantage of calcium borate used in WC's is the improved disposal of scrap material by burning (2:16-19 and Example 2). With plastic resins, this is not an applicable advantage, since unlike the waste from WC's, the valuable plastic scrap material can be, and is, recycled to reduce manufacturing costs.

2. Lloyd's statement that calcium borate particle size is not critical with a preferred range of 150 to 10 microns teaches away from the discovery in this present invention that this size is critical with a preferred range of 20 to 5 microns.

Finally, the present invention resulted in an unexpected discovery regarding the use of calcium borate as a preservative against decay in WPC's. The control of calcium borate's particle size, the robustness of the plastic resin, and the ability of the calcium borate to interact favorably with other additives resulted in a preferred range for optimum performance against decay of half that required for lignocellulosic thermosetting composites (this invention: 0.3% - 1% vs. Lloyds: 0.5% - 2%).

In summary, due to the differences in WPC's and WC's, the prior art references do not contain a suggestion or motivation for their combination and further Lloyd teaches away from a key factor in this present invention. Therefore Applicant requests a reversal of the Office Action position on claims 18, 22, 24, 25,& 26 (13, 16, 17, 18, & 19 after amendments).

Applicant claims that Claim 30 (incorporated into Claim 16 per amendment) is associated with a unobvious use of boric acid.

The OA states that "It would have been prima facie obvious ..... the method of Chow into that of Aida in order to suppress odor (2:36-40). The Applicant agrees that Chow teaches the incorporation of boric acid into one plastic resin, polyethylene, in order to suppress odor associated with manufacture of products using that resin (Abstract). This is also substantiated by an examination of the Examples, all of which seem to be of short duration; ie odor testing shortly after a sample has been produced.

Applicant asserts that Chow neither teaches or suggests the use of boric acid as a preservative of any type, especially one of long duration effectiveness. The present invention asserts that boric acid can be used as a preservative against decay fungus over a long duration of time. Further, Chow does not teach the mixing of boric acid with other borate compounds as is identified in post-amendment Claim 16.

Conclusion

For all the reasons given above, Applicant respectfully submits that all corrections to the specification have been made, the claims define over the prior art under Section 102 due to the new use of the borate compounds as a fungicide in plastics, and the claimed distinctions are of patentable merit under Section 102 because of the numerous

discoveries and unexpected results outlined in this paper. Applicant also submits the double patenting objections are overcome in this response by the explanation of new discoveries and unexpected results. Accordingly Applicant submits this application is now in full condition for allowance.

Respectfully submitted,

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